



NAVAL MEDICAL RESEARCH UNIT DAYTON, OHIO



Science Update

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NAMRU-D MISSION:

To maximize warfighter performance and survivability through premier aeromedical and environmental health research-delivering solutions to the field, the Fleet, and for the future.

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Navy Surgeon General Visits NAMRL



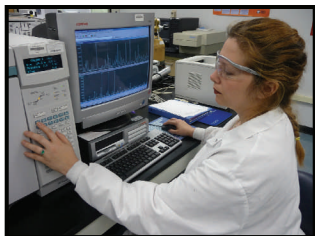
Navy Surgeon General reviews NAMRL scientific achievements and products during laboratory visit while touring the Gulf Coast.

U.S. Navy Surgeon General visited the Naval Aerospace Medical Research Laboratory (NAMRL) on 20 October. The current Naval Medical Research Unit-Dayton (NAMRU-D) Executive Officer and former NAMRL Officer in Charge, presented a Command overview which included briefings on NAMRL's mission, current research programs, product lines, technology transfer accomplishments, as well as, BRAC plans and major milestones. The Surgeon General toured the facility and its laboratories and received a first-hand look at how NAMRL supports the Fleet and warfighter mission.

He recognized NAMRL's critical role in support of Navy Medicine R&D and lauded the laboratory's leading edge aeromedical research and truly outstanding technology transfer accomplishments. He was confident of NAMRL's continued success as a result of the BRAC relocation to Wright-Patterson Air Force Base and merger with the Environmental Health Effects Laboratory (EHEL) to create NAMRU-D. He looked forward to even greater innovation and creativity as a result of the numerous regional partnering opportunities with the 711th Human Performance Wing, Air

Force Research Laboratory, USAF School of Aerospace Medicine, local universities, and Dayton technology transfer activities. Vice Adm. Robinson referred to the establishment of NAMRU-D as a reinvestment in Navy Medicine R&D for the 21st century. NAMRL is proud to be a part of this historic event and is confident the synergy resulting from combining NAMRL and EHRL will result in even greater opportunities to advance operational medicine research and transition our products to the Fleet.

Navy Fuels Go Green



NAMRU-D Scientist

“Recent Navy efforts are aimed at replacing approximately half of the 35 million barrels of fuel with alternative fuels in order to reduce carbon emissions and dependence on foreign oil.”

The Navy currently relies on at least seven types of petroleum-based fuels to power its multitude of ships, aircraft, and other components of its fighting force. Recent Navy efforts are aimed at replacing approximately half of the 35 million barrels of fuel with alternative fuels in order to reduce carbon emissions and dependence on foreign oil. Biofuels generated from fats, plant materials, or other natural resources are particularly promising with two types of biofuels presently undergoing performance-based testing. Hydrotreated Renewable Jet (HRJ) fuel generated from camelina seeds was used as a 50/50 blend with conventional Jet Propulsion (JP)-5 to fly the F/A-18 “Green Hornet” on Earth Day 2010, and a marine biodiesel form of F-76 made from algae was used as a blend to power a River-

ine Command Boat in October.

Despite being biologically based, biofuels still need to undergo a series of toxicological tests to ensure the safety of the military personnel working with, and around, these fuels. Naval Medical Research Unit-Dayton (NAMRU-D) researchers have been working with the Naval Air Warfare Center, Aircraft Division to evaluate HRJ and the algae-based form of F-76 for toxicity and biological effects. To reduce costs and streamline testing, the NAMRU-D team has relied heavily on *in vitro* technologies which expose human lung cells, grown in dishes, to the biofuels and blends directly, or as vapors. Following exposure, the researchers determine damage to the cells by tracking enzyme activity. Addition-

ally, the team also assesses the mutagenic and carcinogenic potential of the biofuels and blends with the Ames assay, a test that utilizes strains of bacteria that are susceptible to DNA mutations and that allow growth under restrictive conditions. To date, the *in vitro* toxicological tests performed by NAMRU-D indicate no evidence of mutagenic events in the DNA with either HRJ or the algae-based F-76 fuel; furthermore that the biofuels themselves are less toxic to human lung cells than conventional fuels. These preliminary data indicate that the risks to military personnel likely will not increase with the use of these alternative fuels, potentially giving the Navy a “green light” for moving to these types of fuels in the near future.



http://www.navy.mil/search/display.asp?story_id=52768

100422-N-XXXXS-001 PATUXENT RIVER, Md. (April 22, 2010) The Navy celebrates Earth Day by showcasing a supersonic flight test of the “Green Hornet,” an F/A-18 Super Hornet strike fighter jet powered by a 50/50 biofuel blend. The test, conducted at Naval Air Station Patuxent River, Md., drew hundreds of onlookers that included Secretary of the Navy who has made research, development, and increased use of alternative fuels priorities for the Department of the Navy. (U.S. Navy photo by Kelly Schindler/Released)

NAMRU-D Collaborates with US Army to Improve RDX Risk Assessments

Since it was first manufactured over a century ago, Royal Demolition Explosive (RDX) has proven its value as a powerful military explosive. However, RDX is also a toxic compound that can produce seizures and other undesirable effects in laboratory animals. Because RDX from production processes and unexploded ordnance may inadvertently contaminate soil and groundwater, agencies have established clean-up levels of RDX in these environmental media that are expected to produce no risk or an acceptable level of risk for people potentially exposed.

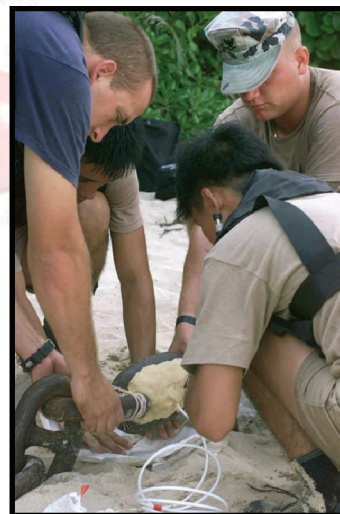
The U. S. Environmental Protection Agency is in the process of re-evaluating their existing toxicological reference values for RDX, the values used to determine appropriate clean-up levels. In support of this updated assessment, Naval Medical Research Unit-Dayton (NAMRU-D) risk assessors are working in collaboration with toxicologists at the U. S. Army Public Health Command (USAPHC) to apply state-of-the-science methods for identifying acceptable exposure levels of RDX. To date, NAMRU-D and USAPHC scientists have evaluated the non-cancer effects of RDX. They have determined that the current long-term (chronic) reference dose for ingestion could

be increased over 20-fold and still be protective of human health. This substantial increase from the current reference value was due to the use of state-of-the-science dose-response analyses and the use of physiologically-based pharmacokinetic (PBPK) models of RDX which allows more precise extrapolations of dose (and thus risk) between rodents and people.

A related effort underway at NAMRU-D is generating new data on blood and tissue levels of RDX in mice. In the key cancer bioassay for RDX, the only significant finding was a modest increase in liver tumors in female mice, but not in male mice, or rats of either sex. NAMRU-D will use the new data to create a PBPK model of RDX in mice, and much like the approach used for the non-cancer reference value described above, will use this model to more accurately assess the cancer potency of RDX in people.

With the completion of assessments for both cancer and non-cancer endpoints by NAMRU-D and USAPHC, Department of Defense risk managers will be in a better position to determine safe, health-protective clean-up levels for RDX in soil and groundwater. It is very likely

that updated assessments based on the research conducted at NAMRU-D will lead to a substantial saving of clean-up costs, while at the same time remain protective of the health of both the personnel at military sites, as well as, the people living in the surrounding communities.



Divers from the U.S. Navy and Republic of Singapore pack RDX-containing "C-4" explosive charges as part of a series of bilateral training exercises involving the U.S. Navy, U.S. Marine Corps, and several Asian countries in 2002. U.S. Navy photo by Ensign Michael A. Harnar (RELEASED)

NAMRU-D Presentations & Products

- (2010, December). *Assessing the non-cancer risk for RDX (Hexadhydro- 1, 3, 5- trinitro-1, 3, 5- triazine) using physiologically based pharmacokinetic (PBPK) modeling.* Abstract presentation at the Joint Army, Navy, NASA, Air Force (JANNAF) Joint Subcommittee Meeting, Orlando, FL.
- (2010). *In vitro exposure and evaluation of military fuels and biofuels. Proceedings of the Joint Army, Navy, NASA, Air Force (JANNAF) Joint Subcommittee Meeting.*
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NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

NAMRL



NAMRL MISSION: To conduct research, development, test, and evaluation in aerospace medicine and related sciences to enhance the health, safety and operational readiness of navy, marine corps, and other military personnel.

Pensacola, FL

NAMRL Research Excellence on Display at AMSUS Annual Meeting

Naval Aerospace Medical Research Laboratory (NAMRL) researchers attended the Association of Military Surgeons of the United States (AMSUS) 116th Annual Meeting in Phoenix, Arizona during the first week of November. Two Principal Investigators showcased their most recent research at the Association of Medical Service Corps Officers of the Navy (AMSCON) Annual Joint Poster Session. One of the Principal Investigators presented three posters, which examined potential methods to counteract stress symptoms during Survival, Evasion, Resistance, and Escape (SERE) training and highlighted recent findings from NAMRL's Operational Stress and Resilience Program (OSRP). Another Principal Investigator presented a poster review on the effects of acute hypoxia on visual performance.

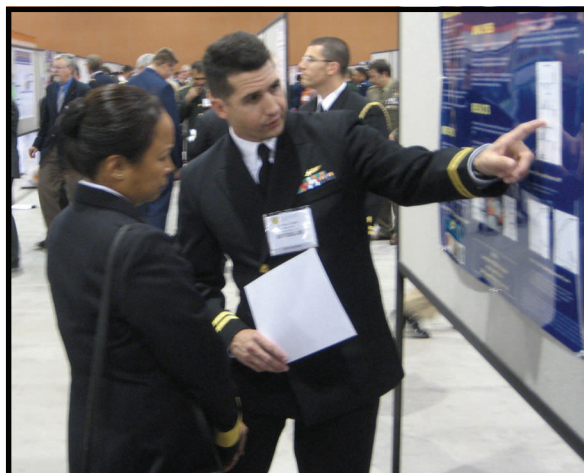
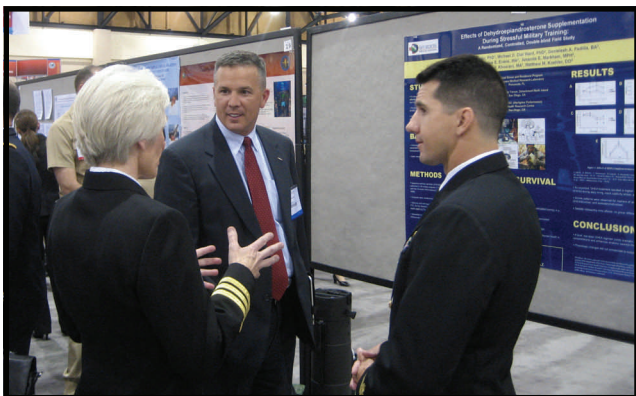
NAMRL's research excellence was also on display during the AMSUS Annual Awards Ceremony. One of the investigators was recognized as the Navy's service nominee for the Rising Star Award, which is given to an individ-

ual who has made a significant achievement within their federal health care discipline and is on an ascending path to executive leadership.

The AMSUS Awards Committee selected the former NAMRL Officer in Charge and newly appointed Naval Medical Research Unit-Dayton (NAMRU-D) Executive Officer as the recipient of the 2010 Research and Development Award for her research on the efficacy of intranasal scopolamine as a motion sickness countermeasure during military operations. The 116th AMSUS General Chairperson, and Navy Surgeon General, presented her the honor, which is bestowed upon an individual who has made significant contributions to the advancement of medical research and development.



Navy Surgeon General, presents the former NAMRL OIC with the R&D Award at AMSUS Annual Awards Ceremony



Left: NAMRL Research on display at the AMSCON Annual Joint Poster Session.

Above: Principal Investigator briefs the Commander of NMSC on the latest research out of NAMRL's Operational Stress and Resilience Program.

An Update On NAMRL's Latest Hypoxia Project

Over the last several months the NAMRL hypoxia research team has been focused on preparation for an upcoming study on the effect of acute hypoxic stress on vital cognitive and perceptual processes. The most recent in a line of related studies, the new effort focuses not only on the break down of these processes but also how they recover. The study includes measures of simple cognitive and perceptual processes such as visual acuity and simple reaction time, as well as, higher-order processes such as executive function. "Our goal is to determine whether hypoxia affects both simple and higher-order processes similarly and concurrently, or if some processes are temporarily preserved at the expense of others," said the project's Principal Investigator. "We are also trying to develop a more accurate picture of the recovery sequence of these vital processes. Earlier work done in our laboratory suggests that full cognitive perceptual recovery lags sig-

nificantly behind the restoration of most measures of blood oxygen saturation."

In addition to examining hypoxia's effect on cognition and perception, NAMRL scientists will test the feasibility of in-cockpit monitoring of brain oxygen saturation using near infrared spectroscopy (NIRS) as part of a hypoxia early detection and warning system for naval aviators. Preliminary data suggest that NIRS measurements taken from the cerebral cortex correlate more closely with the recovery of cognition and perception than measurements taken from other places on the body, such as the finger. "NIRS measurements taken from the cerebral cortex appear to respond more quickly to the onset of hypoxic stress and provide a more accurate picture of the recovery of cognitive perceptual processes following exposure than other measures," Dr. Phillips said. Currently there is no physiological monitoring system in any naval aircraft

to warn pilots of an impending hypoxic episode.

NAMRL researchers are poised to execute the Navy's latest effort to expand our knowledge of hypoxia's effect on basic cognitive and perceptual processes that are critical to mission safety and success. The upcoming study requires the calibration of several advanced physiological and psychological data acquisition systems including measures of blood oxygen saturation, pupillometry, expired gas, and cognitive perceptual performance. Experimental trials are scheduled to begin in January and conclude this spring.



Left: Principal Investigator and Research Assistant monitor subjects during hypoxia exposure via a video camera mounted inside the testing booth and a computer monitor located outside of the booth.



Above: Hypoxia test subjects wear two near infrared spectroscopy (NIRS) sensors on the forehead.

NAMRL Presentations

- (2010, October). *Using X-Plane as a reliable, ecologically valid measure of vigilance in a fatigue study with student naval aviators.* Presented at DOD Human Factors Engineering Technical Advisory Group Meeting 64, San Jose, CA.
- (2010, October). *Effects of acute hypoxia on visual performance: A literature review.* Poster presented at Association of Military Surgeons of the United States Annual Meeting, Phoenix, AZ.
- (2010, October). *Cognitive performance recovery following exposure to acute hypoxic stress.* Presented at DOD Human Factors Engineering Technical Advisory Group Meeting 64, San Jose, CA.
- (2010, October). *A comparison of approaches to detect deception.* Poster presented at Association of Military Surgeons of the United States Annual Meeting, Phoenix, AZ.
- (2010, October). *Effects of psychological skills training during military survival school: A randomized controlled field study.* Poster presented at Association of Military Surgeons of the United States Annual Meeting, Phoenix, AZ.

BRAC Update

The BRAC transition remains on target with the MILCON project currently 3% ahead of schedule (95% actual versus 92% scheduled). Recent efforts have focused on ensuring the smooth integration of major research devices with the MILCON. This has required continued coordination with the Corps of Engineers, Joint Venture Team, and device vendors and is critical to maintaining research capabilities during the transition process. Environmental Tectonics Corporation

has completed several fabrication milestones and will soon be granted joint occupancy to begin on-site mobilization efforts and installation of major research device components. The Vertical Linear Accelerator and Visual Vestibular Sphere Device installation schedules are being finalized and remain in line with MILCON milestones. The BRAC team looks forward to the challenges over the next nine months as we enter the home stretch and near project completion.



Disorientation Research Device Tower and Cassette Assembly with motors attached

“While simulator training and research are commonly used, consistently quantifying flight simulator performance in a valid, reliable way for use in applied research remains a challenge.”

NAMRL Scientists Present at 64th HFETAG Meeting

The Department of Defense Human Factors Technical Engineering Advisory Group (HFETAG) held its 64th meeting in San Jose, CA in October, bringing together scientists from across the Department of Defense services and agencies for discussion of recent advancements in Research and Development. Two of Naval Aero-

space Medical Research Laboratory’s (NAMRL) principal investigators, presented recent work from the hypoxia and fatigue laboratories. One principal investigator discussed cognitive performance recovery following exposure to acute hypoxic stress. Previous laboratory studies of hypoxia measured recovery with self-report and /or traditional pulse oximetry (such as on the finger). However, recent data from NAMRL’s hypoxia lab suggest that cognitive performance recovery may lag behind these standard measures, uncovering a potentially dangerous gap between perceived and actual recovery. The doctor presented these findings in the context of an ongoing follow-up study in which recovery profiles will be observed with greater detail over a longer period of time. The other principal investigator discussed the use of an inexpensive, off-the-shelf flight

simulator as a reliable, ecologically valid measure of vigilance in fatigue studies. While simulator training and research are commonly used, consistently quantifying flight simulator performance in a valid, reliable way for use in applied research remains a challenge. Well established fatigue assessment tools, such as the Psychomotor Vigilance Task (PVT), offer clear, consistent results, yet lack the realism of flight simulation. The principal investigator also presented preliminary evidence of reliability and validity of a simple flight simulation profile, compared to PVT performance, in an acute sleep restriction study; further testing is ongoing. Both presentations highlighted the continued focus of NAMRL’s science team in fulfilling its mission to serve the Fleet, even as the BRAC transition to Wright-Patterson Air Force Base approaches.



Naval aviator completes the NAMRL flight simulation vigilance task. Results were presented at the HFETAG.

Commanding Officer's Corner

It is a pleasure kicking off the first combined Environmental Health Effects Laboratory/ Naval Aerospace Medical Research Laboratory *Science Update* under our new Naval Medical Research Unit-Dayton (NAMRU-D) Command seal. If you were able to attend our activation ceremony on 6 October you heard a description of the symbology of our new logo. For those who did not make it I would like to share the foundation upon which our Command is built. The tactical jet and aircraft carrier represent the war fighting Sailors and Marines who will be supported by our mission. The microscope, Erlenmeyer flask, and double strand of DNA represent the research to be done in aviation medicine, toxicology, and the allied sciences. The caduceus is a winged staff with two serpents wrapped around it as a symbol of the medical profession. Within our logo it is formed as the two serpents wrap around the extended anchor of Naval Aviation's wings of gold, representing Navy Medicine's support role to the fleet. Surrounding the whole is a nautical rope, encompassing both the Fleet and Navy Medicine working together. The colors navy blue and gold are the traditional colors for the Navy while the red represents the Marine Corps. The lighter blue in the center represents a background of ocean water, the basis for all naval operations.



Commanding Officer

Dayton, Ohio is the perfect location for our new Command, not only because of the high quality of its Department of Defense laboratories, but also because it is supported by a number of excellent universities: the University of Dayton, University of Cincinnati, and Wright State University. In addition, the Dayton Development Coalition and the State of Ohio have an aggressive plan to attract and support research and development activities in our core strength areas. All of these resources have not only assisted in the establishment of the new Command, but will serve us well as we execute our mission of maximizing warfighter performance and survivability through premier aeromedical and environmental health research- delivering solutions to the field, the Fleet, and for the future.

NAMRU-D is primed to lead the way forward in our key capability areas of inhalation toxicology, environmental health effects analysis, biomedical sciences, human performance in extreme environments, and acceleration and sensory sciences. This is a very exciting time in the life of our Command and I hope that all who read our *Science Update* will come to appreciate the superlative research we are doing here at NAMRU-D. Have a happy and safe holiday season, and look to future editions for information on our ribbon cutting ceremony tentatively scheduled for 1 Jun 11.

Taking the Helm of Navy Medicine's Aeromedical & Environmental Health Research



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